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Add CDPHE PA/SI Unit Leader
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Always make sure that CDPHE gets Colorado site docs ~~too~~.

ANALYTICAL RESULTS REPORT for SITE REASSESSMENT

UPPER ANIMAS MINING DISTRICT
Silverton, San Juan County, Colorado

CERCLIS ID# CO0001411347

TABLE OF CONTENTS

TABLE OF CONTENTS, cont.

FIGURES

TABLE OF CONTENTS, cont.

TABLES

APPENDICES (under separate cover)

Waste Pile XRF Data not included - may provide some screening backup data

1.0 INTRODUCTION

This Analytical Results Report (ARR) for the Upper Animas Mining District Site Reassessment (SR) in Silverton, San Juan County, Colorado, has been prepared to satisfy the requirements of Technical Direction Document (TDD) No. 1008-13 issued to URS Operating Services, Inc. (UOS) under the U.S. Environmental Protection Agency (EPA) Region 8 Superfund Technical Assessment and Response Team 3 (START) Contract No. EP-W-05-050. This report has been prepared in accordance with the EPA "Guidance for Performing Site Inspections under CERCLA," Interim Final, September 1992, and the "Region 8 Supplement to Guidance for Performing Site Inspections under CERCLA" (EPA 1992, 1993). Field work at the Upper Animas Mining District site included a site reconnaissance in September 2010 and the sampling activities that were conducted during the week of October 25, 2010. Site activities followed the Site Inspection (SI) format and the Generic Quality Assurance Project Plan and the applicable UOS Technical Standard Operating Procedures (TSOPs) (UOS 2005a, b). add early November dates too

47 SW/47 Sed; 4 aqueous source (mine discharge)/4 mine discharge sediments; 3 duplicate SW and 3 duplicate sediments
The field activities conducted by UOS specifically included the collection of 54 surface water samples, 54 sediment samples, and 14 source soil samples; these sample numbers include field duplicate samples and field Quality Assurance/Quality Control (QA/QC) samples (in addition to the laboratory matrix spike/matrix spike duplicate [MS/MSD]) (Table 1). make sure these numbers correspond to section 8.0

The soil and sediment samples were shipped via FedEx to a Contract Laboratory Program (CLP), Routine Analytical Services (RAS) laboratory, ALS Laboratory Group in Salt Lake City, Utah. Soil and sediment samples were analyzed for Target Analyte List (TAL) metals and polychlorinated biphenyls (PCBs). Surface water samples were hand-delivered to EPA Region 8 Environmental Services Assistance Team (ESAT) Laboratory in Golden, Colorado. Water samples were analyzed for total and dissolved TAL metals. This ARR is intended to be used in conjunction with the Upper Animas Mining District Field Sampling Plan (FSP) that was approved by EPA on October 21, 2010, and the Upper Animas Mining District Trip Report (UOS 2010, 2011a). (chk FSP to see if total dis. planned)

2.0 OBJECTIVES

Previous investigations in the Upper Animas Mining District identified the tailings piles and adit discharges as sources of contamination, but did not yield conclusive information regarding possible migration of contaminants into the Groundwater Pathway, Surface Water Pathway, and the Soil Exposure Pathway. This SR was performed to determine if any contamination from targeted areas on upper Cement Creek, in the Upper Animas Mining District site has migrated into the environment where it is impacting environmental and/or human health

& of both not analyzed, explain why in later applicable section targets. The purpose of this SR was to gather information for the evaluation of this site with regard to the EPA's Hazard Ranking System (HRS) criteria (Office of the Federal Register [OFR] 1990). The specific objectives of this SR were:

See FSP objectives

- Document and evaluate source areas; including waste volumes — needs addressed in deviations & if snow cover made that difficult to initially fixed. May be able to do with other imagery
- Document overland flow of water to Cement Creek &
- Evaluate targets for the groundwater, surface water, soil, and air pathways;
- Evaluate non-sampling data documenting past observed releases from site source areas;
- Collect surface water samples to document a release to Cement Creek and the Animas River;
- Collect sediment samples to document a release to Cement Creek and the Animas River; the same?
- Document target locations for fisheries and wetlands; ~~and~~
- Document fisheries use; and
- Collect soil (source) samples to characterize potential contaminants at the site and characterize the extent of surface soil contamination that may affect overland water flow to Cement Creek.
- Collect soil samples to characterize pot. contaminants at the site in other recreationalists.

3.0 SITE DESCRIPTION

Cement Creek originates high in the rugged San Juan Mountains of southwestern Colorado near the San Juan County and Ouray County line on the south slopes of Red Mountain Number 3 and the north slopes of Storm Peak. Cement Creek begins at an elevation of 13,000 feet above mean sea level (MSL) and flows 7 miles southward to an elevation of 9,305 feet above MSL at its confluence with the Animas River at Silverton, Colorado (Figures 1 and 2) (Colorado Department of Public Health and Environment [CDPHE] 1998). The name Cement Creek probably refers to the iron rich precipitates (ferricrete) that coat and cement the stream bed materials (U. S. Geological Survey [USGS] 2007e). This investigation ~~will~~ focused on the largest sources of unremediated mine waste in Upper Cement Creek (above Gladstone) including the American Tunnel, Gold King 7 Level Mine, Red and Bonita Mine, Mogul Mine, Mogul North Mine (also known as the Mogul Sublevel 1), Grand Mogul Mine, Queen Anne Mine, and potentially the Columbia Mine and the Adelphin Mine. These mines and discharges will henceforth be referred to as the "upper Cement Creek mines." This investigation also addressed potential PCB contamination in the aforementioned sources and discharges? sediments of Cement Creek and the Animas River.

need to account for discharges as sources in their 4 too.

Remove or reword to reflect sources that were actually characterized

3.1 SITE HISTORY

The rugged and relatively inaccessible western San Juan Mountains were first prospected by the Baker party, which explored the area around Silverton in 1860. After a treaty with the Ute Indians was revised, mining began in 1874, and George Green brought the first smelter equipment into the area at Baker's Park that year (Silverton Magazine 2009). The extension of the railroad from

If important sources & pathway samples were missed

Silverton up Cement Creek to Gladstone in 1899 encouraged the mining of low grade ores, and the establishment of a lead-zinc flotation plant in 1917 allowed for the treatment of the low grade complex ores found in the area (USGS 1969). The last producing mine in the area was the Sunnyside Mine, which ceased production in 1991 (USGS 2007c). The closing of the Sunnyside mine occurred after Lake Emma drained into the mine and out the American Tunnel into Cement Creek in 1978. The flood water from the Lake Emma "blow-out" was reported to have flowed down Cement Creek in a 10-foot wall of water that would have transported a large quantity of tailings and other mine waste down Cement Creek to the Animas River (The Silverton Railroads 2009).

Over a 100-year period between 1890 and 1991, mining activities in the Upper Animas River Basin, including Cement Creek, produced the waste rock and mill tailings sources from which contamination spread throughout the Surface Water Pathway. Over 18 million tons of ore were mined from the Upper Animas River Basin area, with more than 95 percent of this being dumped directly into the Animas River and its tributaries in the form of mill waste. Older waste rock piles and stope fillings were reworked and sent to mills as technology allowed lower grade ores to be economically processed. A great deal of abandoned waste was also milled during World War II when many older mining and milling structures were cannibalized for scrap metal. The history of mining and milling in the Cement Creek area can be divided into four eras, each of which produced different types and volumes of mine wastes.

- Phase 1 The Smelting Era (1871-1889). Mines were usually small, mining was done by hand, milling was rarely done, and small amounts of often highly mineralized rock were left in surface dumps. Zinc minerals were preferentially removed from the ore and left in mine dumps because zinc created problems during the smelting process. Total production of the entire Upper Animas River area during this era is estimated to be 93,527 short tons. Very little mine or mill tailings were directly discharged into the area streams (USGS 2007c).
- Phase 2 The Gravity Milling Era (1890-1913). Federal government support coupled with the introduction of higher capacity mining and milling techniques encouraged the mining of lower grade ores. Milling became the predominant ore processing method as ore values dropped and tonnage increased. Large volumes of mine and milling wastes were discharged directly into streams.

include a "data gap" section to discuss these

Gravity mills recovered as much as 80 percent of the metals; however, zinc, iron pyrite, and some copper compounds were not recoverable, and when discharged into the streams, were easily spread downstream throughout the environment. Between 1890 and 1913 the total production of the entire Upper Animas River area was estimated at 4.3 million short tons (USGS 2007c). Approximately 95 percent of the waste generated during this era was discharged directly into the area streams (USGS 2007c).

- Phase 3 The Early Flotation Era (1914-1935). The increased demand for metals caused by World War I further accelerated the trend to larger scale mining and milling in the area. Ball mill grinding and froth flotation for concentrating ores were introduced, and again most mill tailings were dumped directly into area streams. During this era total production of the entire Upper Animas River area was estimated at 4.2 million short tons, of which only 36,232 short tons were shipped out of the area to be smelted (USGS 2007c).
- Phase 4 The Modern Flotation Era (1936-1991). Mining almost came to a halt during the Great Depression, but mining activity resumed during World War II when many mines and mills were reopened with substantial support from the federal government. In addition to the newly mined material, waste rock from abandoned mines, in both the waste dumps and the old underground stope fills, was reclaimed and processed. Mining and milling processes improved in detail, but still used familiar technology. The major change was the impoundment of mill tailings that began as a result of a 1935 Colorado Supreme Court ruling that required operations to contain mill tailings. Some early attempts to contain mill tailings were not completely successful and resulted in catastrophic releases of mill tailings to area streams. Mining and milling in the Upper Animas River area had substantially decreased by 1953, and all mining and milling activity ceased in 1991. During this era total production of the entire Upper Animas River area was estimated at 9.5 million short tons. All mill tailings were impounded in settling ponds except for an estimated 200,000 short tons of mill tailings that were released into the Animas River area streams. Ore shipments to smelters totaled only 8,148

tons out of the 9.5 million short tons of production during this final era (USGS 2007c).

more info[r]mation may be needed

Reclamation activities have been ongoing in the Cement Creek basin since 1991 when tailings were removed from the Lead Carbonate Mill site. Reclamation work has also been conducted in Gladstone at the American Tunnel waste dump and portal, Herbert Placer settling ponds, and the Gold King 7 Level Mine. Downstream of Gladstone on Prospect Gulch, several mine sites have been remediated, including the Galena Queen Mine, Hercules Mine, Henrietta Mine, and most recently at the Joe and John Mine and the Lark Mine in 2006 and 2007 (Animas River Stakeholders Group [ARSG] 2007). No new reclamation activities were initiated in 2008 or 2009 (ARSG 2009). In 2010, the EPA initiated a removal assessment at the Red and Bonita Mine. EPA and the Bureau of Land Management (BLM)/U.S. Department of Agriculture (USDA)-Forest Service are also investigating the viability of removal assessments at the Grand Mogul Mine, which consists of both privately and federally-managed parcels.

3.2 SITE CHARACTERISTICS

3.2.1 Physical Geography

The Cement Creek drainage of the Upper Animas Mining District site is located north of the Town of Silverton, Colorado and is located on a combination of public and private property. The elevation of the Cement Creek drainage ranges from 9,305 to 13,000 feet above MSL (USGS 1955).

3.2.2 Geology

The Cement Creek basin is located in the volcanic terrain of the San Juan Mountains. The area was a late Oligocene volcanic center where the eruption of many cubic miles of lava and volcanic tuffs covered the area to a depth of more than a mile (USGS 1969). The formation of the 10-mile diameter Silverton caldera produced faults that are generally concentric circular features. The caldera collapse was followed by multiple episodes of hydrothermal activity that produced widespread alteration and mineralization of the rocks (USGS 2007a). Cement Creek flows through the middle of the old Silverton caldera (EPA 1999).

The predominant rock type found in the Cement Creek Basin is the Oligocene Age Silverton Volcanics. The Silverton Volcanics are lava flows of intermediate to silicic composition and related volcaniclastic sediments that accumulated to a thickness of approximately 1,000 feet around older volcanoes prior to the subsidence of the Silverton Caldera (USGS 2002).

The regional propylitization of the rocks in the area prior to the collapse of the calderas created an altered regional rock type that contains significant amounts of calcite ($CaCO_3$), epidote ($Ca_2Fe(Al_2O)(OH)(Si_2O_7)(SiO_4)$), and chlorite ($(MgFeAl)_6(SiAl)_4O_{10}(OH)_8$), all of which contribute to the intrinsic acid-neutralizing capacity of the major regional rock type. Three major areas of post-caldera collapse mineralization and alteration have been identified in the Cement Creek drainage. The Ohio Peak-Anvil Mountain (OPAM) area on the west side of the lower Cement Creek drainage and the Red Mountains area on the northwest side of the upper Cement Creek drainage are both sites of 23-million-year-old acid-sulfate mineralization. The Eureka Graben area on the upper northeast side of the Cement Creek drainage is the site of 10- to 18-million-year-old emplacement of northeast-trending polymetallic veins of silver, lead, zinc, copper, and often gold that formed as fracture or fissure filling material (USGS 2007d).

The Red Mountain and OPAM acid-sulfate hydrothermal systems cover 22 square kilometers and 21 square kilometers, respectively, along the margin of the collapsed Silverton Caldera on the west and northwest side of the Cement Creek Drainage (Figure 2). Most of the mineralization and mining activity in these two areas has occurred in the Red Mountain area with mines and adits related to the Red Mountain acid-sulfate system found in Prospect, Dry, Georgia, and Corkscrew Gulches, all tributaries of Cement Creek. The ores from these mines commonly contain enargite (Cu_3AsS^4), galena (PbS), chalcocite (Cu_2S), tetrahedrite ($(Cu,Fe)_{12}(Sb,As)_4S_{13}$), stromeryite ($AgCuS$), bornite ($Cu_5FeS_4$), chalcopyrite ($CuFeS_2$), and pyrite ($FeS_2$) along with elemental arsenic (As), copper (Cu), lead (Pb), and iron (Fe) (USGS 2007d).

Mineralization in the veins of the Eureka Graben area that is drained by upper Cement Creek include massive pyrite and milky quartz (FeS_2—$Si0_2$), chalcopyrite ($CuFeS_2$), galena (PbS), sphalerite (ZnS), fluorite (CaF), and elemental gold (Au) and silver (Ag) (USGS 2007d).

The San Juan Mountains were nearly covered by alpine glaciers during the latest Pleistocene Pinedale glaciation. The thickness of glacial ice is estimated to have ranged from approximately 1,400 feet thick at Gladstone to 1,700 feet thick at Silverton. The Pinedale glaciation ended approximately 12,000 years ago and, except for the glacial till deposits, all surface sediments along Cement Creek were likely deposited after that time (USGS 2007e). Recent human activities have had relatively little influence on the overall shape and physical processes of Cement Creek (USGS 2007e).

3.2.3 Hydrogeology

Approximately 6,000 years ago, Cement Creek cut into the creek bed sediments by as much as 16 feet, causing a drop in the valley bottom shallow water table aquifer. Beginning about A.D. 400, Cement Creek aggraded the stream bed by as much as 10 feet, then between A.D. 1300 and A.D. 1700, Cement Creek cut back to the previous level established approximately 6,000 years ago. These changes in the shallow water table elevations in the valley caused mineralization and cementation of the sediments in the stream course (USGS 2007e).

Groundwater in the Cement Creek area is found in cracks and fissures in the near surface of the igneous rocks that comprise the majority of the area.

3.2.4 Hydrology

The drainage area of Cement Creek is 20.1 square miles (USGS 2007b). Cement Creek flows through the middle of the old caldera, with the period of high flow being May, June, and July in response to snowmelt in the San Juan Mountains, and the periods of low flow occurring in later winter and late summer (EPA 1999). The average flow measured by the USGS on Cement Creek at Silverton before the confluence with the Animas River at station number 09358550 (also known as CC48) between 1992 and 2008 (excluding 1994) was 38.3 cubic feet per second (cfs). The highest average flow on Cement Creek was 56.3 cfs during 1995 and the lowest was 17 cfs during the drought of 2002 (USGS 2009). The drainage area of the Animas River is 146 square miles (USGS 2007b). The average flow measured by the USGS on the Animas River below Silverton at station number 09359020 (also known as A72) between 1992 and 2008 was 281 cfs (USGS 2009).

3.2.5 Meteorology

The Upper Animas River Basin and Cement Creek are located in an alpine climate zone. The average annual precipitation in the area is about 40 inches (National Oceanic and Atmospheric Administration [NOAA] 1973). Winter snowfall is heavy, and severe rain storms occur in the summer (USGS 1969). The average total precipitation for Silverton, Colorado as totaled from the Western Regional Climate Center database is 24.50 inches. The 2-year, 24-hour rainfall event for this area is 2 inches (NOAA 1973).

3.3 PREVIOUS INVESTIGATIONS

- March 1995 — *Reconnaissance Feasibility Investigation Report of the Upper Animas River Basin.* Colorado Division of Minerals and Geology. J. Herron, B. Stover, P. Krabacher, and D. Bucknam.
- October 1995 — *Animas Discovery Report – Upper Animas River Basin.* CDPHE – Hazardous Materials and Waste Management Division. Camille Farrell.
- February 1997 — *Water Quality and Sources of Metal Loading to the Upper Animas River Basin.* CDPHE – Water Quality Control Division. J. Robert Owen.
- July 1997 — *Sampling and Analysis Plan for a Site Inspection of the Upper Animas Watershed, Silverton Mining District, San Juan County, Colorado.* CDPHE – Hazardous Materials and Waste Management Division. Camille Farrell.
- April 1998 — *Analytical Results Report, Cement Creek Watershed, San Juan County, Colorado.* CDPHE Hazardous Materials and Waste Management Division. Camille Farrell. Five ground water, 6 surface water, 53 sediment, and 15 source samples collected in 1996. Data validation reports are not available. These data are not usable for a HRS evaluation of the site because sample locations are not documented and data validation cannot be documented.
- September 1998 — *Cement Creek Reclamation Feasibility Report, Upper Animas River Basin.* Colorado Division of Minerals and Geology. Jim Herron, Bruce Stover, and Paul Krabacher. Forty waste rock locations and

four soil locations in the Cement Creek drainage were sampled by collecting a liquid extract of the rock or soil material from 10 to 20 aliquots at each location. These data are not usable for a HRS evaluation of the site because the analytical results are for extracts from composite samples.

- March 1999 — *Site Inspection Analytical Results Report for the Upper Animas Watershed, San Juan County, Colorado*. CDPHE – Hazardous Materials and Waste Management Division. Camille Farrell. Samples of mine waste rock, seeps, surface water, and sediment collected in 1997. Exact locations of samples were not documented. Photographs of sample locations are available. Data validation reports are not available. These data are not usable for an HRS evaluation of the site because sample locations are not documented and data validation cannot be documented.
- May 2009 — *Routine Water Quality Sampling, EPA Region 8 Laboratory.* On a monthly basis from May 2009 until the present, EPA personnel have conducted sampling activities at select locations in the Animas River, Cement Creek, and Cement Creek tributaries. At each location EPA personnel collected field data and samples for cations, anions, acidity, total dissolved solids (TDS), total suspended solids (TSS), and total and dissolved metals. Data has been published into a SCRIBE database and in summary spreadsheets made available to the ARSG.

4.0 SOURCES (WASTE CHARACTERISTICS)

Describe # of source areas, and then source types at each area

There are eight sources of potential contamination identified at the Upper Animas Mining District site, all of which are aqueous or soil sources.

The first source area consists of the waste rock piles and mine discharge at Grand Mogul Mine. The waste rock piles near the portal of the mine are uncovered and easily accessible via the adjacent county road. The waste rock at Grand Mogul Mine consists of three waste rock piles with a total volume of 26,520 cubic yards (UOS 2011c). Water that is exposed to the waste piles flows into Cement Creek. Grand Mogul mine has a collapsed adit, which has had flow rates recorded between 0.004 cubic feet per second

Source Area 1 w/ 3 Waste piles 1 discharge (cfs) in September 2009 and 0.157 cfs in June 2009 (EPA 2011). Metals concentrations observed in the mine discharge (UASW059, Table 2) include 105 micrograms per liter (µg/L) for cadmium, 4,690 µg/L for copper, 33.8 µg/L for lead, and 24,900 µg/L for zinc.

UAAD – ↓ was flat in FSP

Ask CSC about bkgd for sources in mining area

Source Area 2 (1 pile 1 discharge)

The second source area consists of the waste rock piles and [covered by note] e. The waste rock piles are uncovered and easily accessible via the adja[covered by note] ck at Mogul Mine consists of one waste rock pile with a volume of 4[covered by note] c). The adit discharge from Mogul Mine passes through a wetland area, [covered by note] Mogul Mine has a flumed adit, which has had flow rates recorded between 0.095 cfs in July 2010 and 0.178 cfs in July 2009 (EPA 2011). Metals concentrations observed in the mine discharge (UAAD004, Table 5) include 55 µg/L for cadmium, 15.3 µg/L for copper, 271 µg/L for lead, and 31,300 µg/L for zinc.

Source Area 3 1 pile or 2? 1 discharge

The third source area consists of the waste rock piles and adit discharge from the Red and Bonita Mine. The waste rock piles are uncovered and easily accessible via the adjacent county road. The waste rock at Red and Bonita Mine consists of two waste rock piles with a total volume of 3,962 cubic yards (UOS 2011b). The adit discharge from the Red and Bonita Mine flows over waste rock piles, where it is channeled through an iron bog and into Cement Creek. Red and Bonita Mine has a collapsed adit, which has had flow rates recorded between 0.403 cfs in April 2010 and 0.749 cfs in May 2009 (EPA 2011). Metals concentrations observed in the mine discharge (UAAD003, Table 5) include 53.1 µg/L for cadmium, 107 µg/L for lead, and 15,500 µg/L for zinc.

Source Area 4 need done site on what reclamation has been done

The fourth source area consists of the waste rock piles and adit discharge from the Gold King 7 Level Mine. The waste rock piles are uncovered and easily accessible via the adjacent county road. The waste rock piles were not sampled as a part of this investigation because the EPA could not obtain landowner access. The adit discharge from the Gold King 7 Level Mine is channeled through a culvert system and flows into the North Fork of Cement Creek. The North Fork of Cement Creek joins with the main stem of Cement Creek downstream of the Red and Bonita Mine. ? Mogul mine has a flumed adit, which has had flow rates recorded between 0.333 cfs in April 2010 and 0.558 cfs in June 2010 (EPA 2011). Metals concentrations observed in the mine discharge (Chk UAAD002, Table 5) include 54.9 µg/L for cadmium, 4,030 µg/L for copper, 6.82 µg/L for lead, and 18,700 µg/L for zinc.

collected at location (describe where) are these data comparable to Nov 2009 data from the flume closer to the former portal or was this from the NFK of Cement Creek?

Add 4? What about American Tunnel discharge? That's a source area that was characterized

ESAT

In ~~October of 2010~~, START collected samples from each of the potential sources and sent them to a CLP lab or the Region 8 EAST lab for metals analysis. The source soil samples and source aqueous samples contained all of the TAL metals in varying amounts. Several metals that potentially may affect targets

give dates - went into November tho.

AT = Source Area 5

along the pathways are cadmium, lead, manganese, and zinc. See the analytical results in Section 11.0 of this report for concentration ranges for each metal.

5.0 GROUNDWATER PATHWAY

The Town of Silverton does not have a municipal intake on Cement Creek or the Animas River, but obtains its drinking water supply from Bear and Boulder Creeks. Bear Creek is located in unmineralized terrain of the Mineral Creek drainage west-southwest of Silverton between Bear and Sultan Mountains. Boulder Creek flows into the Animas River northeast of Silverton after it passes around the Mayflower Tailings Ponds via a diversion (USGS 1955, Town of Silverton 2009). The Town of Silverton does not utilize groundwater (Town of Silverton 2009).

A review of the groundwater well records for wells in the Cement Creek drainage maintained by the State of Colorado Division of Water Resources identified seven domestic or household use wells. At this time, it is not known if the wells in the Cement Creek drainage are used for obtaining drinking water and therefore, START personnel did not investigate the groundwater pathway as part of this investigation.

Treatability data gap?

6.0 SURFACE WATER PATHWAY

The Surface Water Pathway is the pathway most impacted by mining and milling activities in the Cement Creek drainage. Millions of tons of mine and mill waste were dumped directly into the area streams as a normal operating practice between 1890 and 1935 and to a far lesser extent until 1991 (USGS 2007c). The fine-grained material has had ample opportunity to spread downstream and contaminate stream sediment in the Animas River.

what happened to American Tunnel?

American Tunnel PPE to Cement Creek lowest one.

The sources of impact to surface water in the Cement Creek drainage are adit discharges and flow over waste piles. The main inflows contributing to surface water contamination are the Grand Mogul Mine, Mogul Mine, Red and Bonita Mine, American Tunnel and Gold King 7 Level Mine. The probable point of entry (PPE) at each of these locations is the point where surface water flow enters Cement Creek either in the form of adit discharge or surface water flow over mine waste. The furthest downstream PPE

show PPEs on maps

Did overland flow distances to PPE get evaluated?

There are no surface water intakes along ~~the Animas~~ Cement Creek and the Animas River within the 15-mile downstream limit for drinking water, agricultural, or industrial use, ~~and~~ the first use of surface water below the confluence of Cement Creek with the Animas River is the Tall Timber Ditch Alternative Point 17 miles downstream. The ditch has historically been used for irrigation and is owned by Beggrow Enterprises of Durango, Colorado (Colorado Division of Water Resources 2009). The Animas River is used for occasional sport

Need to get START the Division of Wildlife data showing reduced #s of fish/species in fall 2010 electroshocking.

recreational use (e.g., rafting) within the 15-mile downstream limit, but the relative inaccessibility of the river along much of the stream course mitigates against active recreational use along the entire stretch (Mild to Wild Rafting 2009). Drinking water for the town of Silverton is taken from Bear Creek in the Mineral Creek drainage and from Boulder Creek in the Animas River drainage outside the area of influence of Cement Creek (Town of Silverton 2009).

how far, within TDL

Will need field confirmed

Cement Creek itself does not harbor any aquatic life; however, the Animas River below Silverton is stocked and fished (Colorado Division of Wildlife 2009). Rainbow, brook, and native trout are caught in the Animas River below Silverton and consumed by humans (Outdoor World 2009). Elk Park, located approximately 5 miles downstream of Silverton on the Animas River and accessible only by foot, was specifically identified as a location where fishermen catch and consume fish (Outdoor World 2009).

Don't we have wetlands on Cement Creek too?

Approximately 2,500 feet of streamside wetlands are found along Cement Creek (U.S. Department of the Interior, Fish and Wildlife Service [USDOI] 1998a, c). Iron bogs are found along the middle stretch of Cement Creek. Approximately 3 miles of palustrine and riverine streamside wetlands are found along the 15-mile downstream segment of the Cement Creek and Animas River below the PPE of Cement Creek with the Animas River (USDOI 1998b, d).

isn't PPE (lowest from sources) where American Tunnel discharge enters Cement Creek?

START personnel collected surface water samples from Cement Creek, adit discharges, and the Animas River in October of 2010. Background sample UASW030 was collected from Cement Creek upstream of Grand Mogul Mine. Surface water samples indicated that cadmium, copper, lead, manganese, and zinc were at least 3 times the background level. See analytical results in Section 11.0, as well as Table 2 and Figure 6 in this report, for the concentrations of each metal.

7.0 SOIL EXPOSURE

Source characterization data gap

The Upper Cement Creek area within the Upper Animas Mining District has several sources of mine waste. The sources examined as a part of this investigation included soil from the vicinity of the American Tunnel, the Red and Bonita Mine, Mogul Mine, Grand Mogul Mine, Mogul North Mine, and the Grand Mogul Stope. A soil sample could not be collected from the Gold King 7 Level Mine due to sampling limits in the access agreement with the property owner. The mine sites have very little vegetation and no containment, and mine tailings and waste rock remain exposed to the elements. Access to the mine sites is not restricted in any way. The adjacent roads are used for recreation by ATVs and driven on by hunters and tourists in the area. There are no residents or workers on the mine sites and it is unknown if any people reside in the vicinity of the mine sites.

In October 2010, START collected soil samples from waste rock piles in the Upper Animas Mining District Site.

The lynx, which has been observed in the area, is a federally listed threatened and state-listed endangered species, and the Boreal toad is a state-listed endangered species (Colorado Division of Wildlife 2010). The Boreal toad could live in wetlands adjacent to the stream (Colorado Department of Wildlife 2010).

8.0 AIR PATHWAY

The air pathway was not evaluated as a part of this site reassessment because of the reportedly very low population density in the Cement Creek drainage and the fact that the ground surface is snow covered for at least 6 months out of the year.

Where is the Data Quality Assessment? Please reorder sections so that 9.0, 13.0, 12.0

9.0 DATA QUALITY OBJECTIVES FOR SAMPLING

The EPA Data Quality Objectives (DQO) Process is a seven-step systematic planning approach to develop acceptance or performance criteria for EPA-funded projects. The seven steps of the DQO process are:

Step 1	The Problem Statement;
Step 2	Identifying the Decision;
Step 3	Identifying the Decision Inputs;
Step 4	Defining the Study Boundaries;
Step 5	Developing a Decision Rule;
Step 6	Defining Tolerance Limits on Decision Errors; and
Step 7	Optimizing the Sample Design.

These DQOs were developed by UOS based on information provided by the TDD and the EPA "Guidance for the Data Quality Objectives Process" (EPA 2000).

Based upon the risks associated with the hazardous substances, the project team identified surface water and soil exposure as the pathways of potential concern at the Upper Animas Mining District site during the September 2010 reconnaissance and the October/November 2010 sampling activities.

10.0 FIELD PROCEDURES

10.1 SAMPLE LOCATIONS

This SR involved the collection of 116 field samples and 6 field QC/QA samples (Figures 3, 4, and 5). These samples included 47 surface water samples, 47 sediment samples, 14 source soil samples, ~~4~~ 5 adit water (aqueous source) samples, and ~~4~~ 5 adit sediment samples. Additional QA/QC samples included three duplicate surface water samples and three duplicate sediment samples. ?

Grand Mogul toe seep

Sample identification followed the following format:

- UA (Matrix ID) (Sample Location)

UA stands for Upper Animas Mining District Site. Matrices were identified as follows:

- SE = sediment
- SW = surface water
- SO = soil
- AD = adit discharge

add

Sample locations were then numbered sequentially. Detailed information about the sample nomenclature is in the approved FSP (UOS 2010).

10.1.1 Surface Water Samples

Table 1 shows 46 + 3 46?

Forty-three surface water samples plus three surface water duplicate samples were collected. Surface water samples were collected at points on the Animas River, Cement Creek, and Cement Creek tributaries. Figure 3 shows surface water sample locations.

10.1.2 Sediment Samples

46? 48 + 3

Forty-three sediment samples plus three sediment duplicate samples were collected. Sediment samples were co-located with surface water samples, which were collected at points on the Animas River, Cement Creek, and Cement Creek tributaries. Figure 4 shows sediment sample locations. Please explain UA SE 010 and UA SE 060 situation; which data point was used - was one rejected, discarded, etc

10.1.3 Source Samples

of ~ planned

Samples not collected from the Gold King 7 level waste pile due to lack of landowner access.

Soil Source Samples

Fourteen source soil samples were collected. Samples UASO01 and UASO02 were collected in the vicinity of the American Tunnel. Samples UASO03, UASO04, and UASO05 were collected at the Red and Bonita Mine waste piles. Sample UASO06 was collected at the Mogul North Mine waste pile. Samples UASO07 and UASO08 were collected at the Grand Mogul Stope waste piles. Samples UASO09, UASO10, and UASO11 were collected at the Grand Mogul Mine waste piles. Samples UASO12, UASO13, and UASO14 were collected at the Mogul Mine waste piles. Figure 5 shows the source soil sample locations.

Aqueous Source Samples

~~Four~~ Five aqueous source samples were collected as part of this investigation. Aqueous source samples were collected at adit discharge points at the Mogul Mine, Red and Bonita Mine, Gold King 7 Level Mine, and the American Tunnel. Figure 4 shows surface water sample locations, including aqueous source sample locations.

toe of Grand Mogul is not Cement Creek drainage – see Table 4 – UA SW059 UA SE059 Grand Mogul too?

Adit Sediment Source Samples

~~Four~~ Five adit sediment source samples were collected as part of this investigation. Adit sediment source samples were collected at adit discharge points at the Mogul Mine, Red and Bonita Mine, Gold King 7 Level Mine, and the American Tunnel. Figure 3 shows sediment sample locations, including adit sediment source sample locations.

Same as above

may need to adjust source, SW/sed sample numbers and sections in which results are presented

10.2 SAMPLING METHODS

10.2.1 Surface Water Sampling

parameters should be tabulated in ARR

Surface water sampling was conducted according to UOS TSOP 4.18, "Surface Water Sampling." START personnel measured field parameters, including pH, temperature, and electrical conductivity of each sample, as described in TSOP 4.14, "Water Sample Field Measurements" and Table 6 of UOS TSOPs (UOS 2005b). Field instrumentation was calibrated daily and all calibration and field data were recorded in the field logbook. All surface water samples were collected for dissolved metals. Water was drawn through a 2 micrometer

because...

Explain why no total metals

ck 0.45um usual filter

(µm) filter using a peristaltic pump with disposable dedicated Tygon tubing. The water samples were preserved with nitric acid to a pH <2 and stored on ice. Sampling was conducted from the farthest downstream location to the farthest upstream location to minimize the potential for cross-contamination. All surface water sample locations were photographed and documented in the project logbook during sampling activities (UOS 2010). Surface water sample locations which were found to be dry were photographed and documented in the project logbook. which locations are these? are they in Table 1?

During surface water sampling, START personnel planned to assess wetlands to determine if they meet the 40 CFR 230.3 Definition of a Wetland, but the snow cover on the ground was too extensive to observe wetlands (OFR 2005).

10.2.2 Sediment Sampling

Sediment samples from both streams and adits were collected for total metals and PCB analysis. Sediment sampling was conducted according to UOS TSOP 4.17, "Sediment Sampling" (UOS 2005b). Sediment sampling locations correspond to surface water sampling locations (Figures 3 and 4) (Table 1). START personnel collected sediment samples in conjunction with surface water sampling, and collected the sediment sample after the surface water sample had been collected, proceeding from the most downstream location to the most upstream location. START personnel collected sediment samples using a disposable plastic scoop and a sample jar. Samples for total metals were placed in 8-ounce polypropylene jars, and samples for PCB analysis were placed in 8-ounce amber glass jars. Sediment samples were stored on ice. All sediment sample locations were photographed and documented during sample activities (UOS 2010). At locations UASE012, UASE030, and UASE059 there was not enough sediment to collect samples for PCBs, so only metal samples were collected.

10.2.3 Source Soil Sampling

All 14 of the soil samples collected during the SR were source samples and were collected in accordance with procedures described in UOS TSOP 4.16, "Surface and Shallow Depth Soil Sampling" (UOS 2005b). START personnel dug below snow in several locations on each pile and preformed XRF analysis of the driest soil in the hole. In-situ XRF analysis showed waste piles were homogeneous, so START personnel

?

collected one grab sample from each distinct area of a waste are; for example, one sample per pile, or one sample on each side of large piles. START personnel used disposable plastic scoops for source sample collection. All source samples were collected as biased grab samples from the 6- to 12-inch depth interval, where possible. In the locations in the vicinity of the American Tunnel (UASO01 and UASO02), the ground was too hard to get to the 6-inch depth, and the samples were dug to a depth immediately below the oxidized layer of source material, approximately 2 inches. A pick axe was used to reach the depth needed for the sample and was decontaminated between samples. Sample descriptions were logged in the field logbook. Global Positioning System (GPS) data were collected for each sample location.

Does FSP explain why 6"-12" interval is important?

are GPS data for all samples in table(s)? didn't see them; please add

10.2.4 Adit Water Sampling

Adit water sampling was conducted according to UOS TSOP 4.18, "Surface Water Sampling." START personnel measured field parameters, including pH, temperature, and electrical conductivity of each sample, as described in TSOP 4.14, "Water Sample Field Measurements" and Table 6 (UOS 2005b). Field instrumentation was calibrated daily, and all calibration and field data were recorded in the field logbook. All adit water samples were collected for total and dissolved TAL metals. Dissolved metal water samples were drawn through a 2 μm filter using a peristaltic pump with disposable dedicated Tygon tubing. Total metal samples were collected by immersing the sample bottles directly in the sample media. The water samples were preserved with nitric acid to a pH <2 and stored on ice. All adit water sample locations were photographed and documented in the project logbook during sampling activities.

of UOS compiled TSOPs

above indicated total & dissolved

10.3 ANALYTICAL PARAMETERS

Surface water samples were analyzed for dissolved TAL metals by the EPA Region 8 ESAT Laboratory in Golden, Colorado. Adit water samples were analyzed for dissolved TAL metals by EPA Region 8 ESAT Laboratory located in Golden, Colorado. The standard CLP low water (method SOM01.2) contract quantitation limits are 1 μg/L for lead, 5 μg/L for manganese, 5 μg/L for copper, 1 μg/L for cadmium, and 10 μg/L for zinc (EPA 2010).

concentration ?

The sediment and source soil samples were analyzed through the CLP for TAL metals and PCBs. The standard CLP (method SOM01.2) contract quantitation limits are 1 milligram per kilogram

total

(mg/kg) for arsenic, 0.5 mg/kg for cadmium, 1 mg/kg for lead, 1.5 mg/kg for manganese, 1 mg/kg for silver, 6 mg/kg for zinc (EPA 2010).

11.0 ANALYTICAL RESULTS

The sample data collected during this SR were reviewed using the HRS guidelines for analytical interpretation (OFR 1990). As listed in the analytical results in Tables 2 through 6, elevated concentrations of contaminants reported as significantly above background contaminant values are noted by a star (★) and are determined by sample concentrations based on the following:

- If the background analyte concentration is greater than its Sample Quantitation Limit (SQL), and if the release sample analyte concentration is greater than its SQL, 3 times greater than the background, and 5 times greater than the blank concentration. SQLs should be included
- If the background analyte concentration is not greater than its SQL and if the release sample analyte concentration is greater than its SQL, greater than the background Contract Required Detection Limit (CRDL), and 5 times greater than the blank analyte concentration.

All of the CLP RAS and Region ESAT laboratory data have been validated. The data validation reports are presented in Appendix B. CLP Form I documents are also presented in Appendix B with the validation reports. Sample Quantitation Limits are included in Appendix C.

Previous investigations in the Upper Animas Mining District identified which the tailings piles and adit discharges as sources of contamination, but did not yield conclusive information regarding possible migration of contaminants into the Groundwater Pathway, Surface Water Pathway, and the Soil Exposure Pathway. This SR was performed to determine if any contamination from the Upper Animas Mining District site has migrated into the environment where it is impacting potential environmental and/or human health targets. Contaminants are present at the property at levels equal to or greater than SCDM Reference Dose Screening Concentrations (RDSC), Cancer Risk Screening Concentrations (CRSC) or MCLs (EPA 2004). Analytical results for surface water were compared to SCDM RDSC, CRSC, and MCL values. Analytical results for sediment were compared to background sediment results only. No benchmarks have been established for sediment. Analytical results for soil were compared to SCDM RDSC, CRSC, and MCL values.

which property? have >1 source area

move ~~End of Analytical Results~~

Data gathered as part of this SR concludes that the Surface Water Pathway is affected by sources in upper Cement Creek the Upper Animas Mining District site.

HQ-CSC? Is a Bkgd needed in mineralized area?

Put Source Characterization sections first, then pathway data

~~11.1~~ 11.4 SURFACE WATER RESULTS

Attribution to Sources needs strengthening media-specific

Concentrations of 10 dissolved metals results in the surface water samples exceed the ~~action limits~~ benchmarks set forth for this study for the Surface Water Pathway; of this report will discuss only those metals with SCDM toxicity values. whichever ... Reword this sentence The ~~action limits~~ include 3 times the concentration at the background sample location UASW030, the SCDM CRSC, the SCDM RDSC, and the SCDM MCL. ? Don't understand Surface water samples indicate that aluminum, cadmium, lead, magnesium, manganese, and zinc concentrations were at least 3 times the background levels. Surface water samples indicate that arsenic, cadmium, manganese, and zinc were detected above the SCDM RDSC. Arsenic was detected above the SDCM CRSC. Arsenic, beryllium, cadmium, copper, lead, and thallium were detected above the SDCM MCL.

A total of 24 samples exceed 3 times background concentrations for cadmium. Of those sample locations UASW004, UASW006, UASW008, UASW009, UASW013, UASW014, UASW016, UASW017, UASW018, UASW020, UASW021, UASW023, UASW024, UASW049, UASW050, UASW056, UASW058, and UASW059 are located on Cement Creek, and had cadmium concentrations greater than 3 times the background of 3.09 µg/L at UASW030. Major contributing locations for cadmium were observed from the Grand Mogul Mine, the North Fork of Cement Creek (and the Gold King 7 Level Mine), and Red and Bonita Mine. Cadmium levels in excess of 3 times the background in Cement Creek are not observed in the Animas River. However, the cadmium concentrations in the Animas River downstream of Cement Creek are 3 times greater than cadmium concentrations upstream of Cement Creek.

A total of 36 samples exceed 3 times background concentrations for copper. Of those sample locations UASW002, UASW004, UASW006, UASW008, UASW009, UASW013, UASW014, UASW016, UASW017, UASW018, UASW020, UASW021, UASW023, UASW024, UASW035, UASW036, UASW037, UASW039, UASW041, UASW042, UASW044, UASW046, UASW047, UASW049,UASW050, UASW056, UASW058, and UASW059 are located on Cement Creek, and had copper concentrations greater than 3 times the background of 25.2 µg/L at UASW030. Major contributing locations for copper were observed from the Grand Mogul Mine and the North Fork of Cement Creek (and the Gold King 7 Level Mine). Copper levels in excess of 3 times the background from Cement Creek are not observed in the Animas River. However, the copper concentrations in the Animas River downstream of Cement Creek are 3 times greater than copper concentrations upstream of Cement Creek.

A total of 39 samples exceed 3 times background concentrations for lead. Of those sample locations UASW002, UASW004, UASW006, UASW008, UASW009, UASW013, UASW014, UASW016, UASW017, UASW018, UASW020, UASW021, UASW023, UASW024, UASW035, UASW036, UASW037, UASW039, UASW041, UASW042, UASW044, UASW046, UASW047, UASW049, UASW050, UASW056, UASW058, and UASW059 are located on Cement Creek, and had lead concentrations greater than 3 times the background of 1.86 μg/L at UASW030. Major contributing locations for lead were observed from the Grand Mogul Mine and Red and Bonita Mine. Lead levels in excess of 3 times the background from Cement Creek are observed in the Animas River. In addition, the lead concentrations in the Animas River downstream of Cement Creek are 3 times greater than lead concentrations upstream of Cement Creek.

A total of 43 samples exceed 3 times background concentrations for manganese. Of those sample locations UASW002, UASW004, UASW006, UASW008, UASW009, UASW013, UASW014, UASW016, UASW017, UASW018, UASW021, UASW023, UASW024, UASW035, UASW036, UASW037, UASW039, UASW041, UASW042, UASW044, UASW046, UASW047, UASW049,UASW050, UASW056, UASW058, and UASW059 are located on Cement Creek, and had manganese concentrations greater than 3 times the background of 120 μg/L at UASW030. Major contributing locations for manganese were observed from the Grand Mogul Mine, the Mogul Mine, and Red and Bonita Mine. Manganese levels in excess of 3 times the background from Cement Creek are observed in the Animas River. However, the manganese concentrations in the Animas River downstream of Cement Creek are not 3 times greater than manganese concentrations upstream of Cement Creek.

A total of 36 samples exceed 3 times background concentrations for zinc. Of those sample locations UASW002, UASW004, UASW006, UASW008, UASW009, UASW013, UASW014, UASW016, UASW017, UASW018, UASW020, UASW021, UASW023, UASW024, UASW035, UASW036, UASW037, UASW039, UASW041, UASW042, UASW044, UASW046, UASW047, UASW049,UASW050, UASW056, UASW058, and UASW059 are located on Cement Creek, and had zinc concentrations greater than 3 times the background of 556 μg/L at UASW030. Major contributing locations for zinc were observed from the Grand Mogul Mine and Red and Bonita Mine. Zinc levels in excess of 3 times the background from Cement Creek are observed in the Animas River. In addition, the zinc concentrations in the Animas River downstream of Cement Creek are 3 times greater than zinc concentrations upstream of Cement Creek.

See Table 2 for the surface water sample results and Figure 6 for locations of samples locations and results.

~~11.2~~ 11.5 SEDIMENT RESULTS

Concentrations of seven metals in the sediment samples exceeded the action limits set forth for this study in the Surface Water Pathway; this report will discuss only those metals with SCDM toxicity values. The action limit for sediment is 3 times the concentration at the background sample, UASE030. Sediment samples indicated that arsenic, beryllium, lead, and silver were at least 3 times the background levels at select locations. Arsenic concentrations were at least 3 times higher than the background concentration (31.5 mg/kg) in two sediment samples, UASE046 (115 mg/kg) and UASE059 (969 mg/kg). Beryllium concentrations were at least 3 times higher than the background concentration (1.4 mg/kg) in one sediment sample, UASE046 (10.3 mg/kg). Lead concentrations were at least 3 times higher than the background concentration (1,480 mg/kg) in one sediment sample, UASE006 (5,720 mg/kg). Silver concentrations were at least 3 times higher than the background concentration (1.2 mg/kg) in 12 sediment samples, UASE001 (4.5 mg/kg), UASE006 (12.1 mg/kg), UASE014 (8.5 mg/kg), UASE015 (3.9 mg/kg), UASE019 (5.1 mg/kg), UASE022 (27.1 mg/kg), UASE023 (11.8 mg/kg), UASE024 (4.0 mg/kg) UASE040 (3.6 mg/kg), UASE046 (4.1 mg/kg), UASE058 (5.0 mg/kg) and UASE059 (13.2 mg/kg).

Sediment samples were also submitted for PBC analysis. No PCBs were detected in sediment samples above method detection limits.

See Table 3 for the sediment sample results and Figure 7 for sample locations and results. Adit sediment samples are discussed separately under Section 11.5.

11.1 ~~11.3~~ SOURCE SOIL RESULTS

The source soil samples contained all of the TAL metals in varying amounts. Aluminum concentration ranged from 665 mg/kg at Grand Mogul Mine to 19,500 mg/kg at Mogul Mine. Antimony concentrations ranged from non-detect in the area of the American Tunnel to 13.5 mg/kg at Mogul North Mine. Arsenic concentrations ranged from 9.1 mg/kg at Red and Bonita to 96.8 mg/kg at Grand Mogul. Cadmium concentrations ranged from non-detect at multiple locations to 35.4 mg/kg at Red and Bonita. Copper concentrations ranged from 33.1 mg/kg at Grand Mogul Mine to 4,600 mg/kg at Grand Mogul Mine. Lead concentrations ranged from 241 mg/kg at the American Tunnel to 15,500 mg/kg at Grand Mogul Mine. Magnesium concentrations ranged from non-detect at multiple locations to 12,700 mg/kg at Grand Mogul Mine. Manganese concentrations ranged from 122 mg/kg at Grand Mogul Mine to 5,570 mg/kg at Mogul Mine. Nickel concentrations ranged from non-detect at multiple locations to 9.5 mg/kg at Mogul Mine. Silver concentrations ranged from 1.3 mg/kg at the American Tunnel to 113 mg/kg at Grand Mogul Mine. Zinc concentrations ranged from 102 mg/kg at the American Tunnel to 11,300 mg/kg at Red and Bonita Mine. See Table 4 for source sample results and Figure 8 for soil sample locations and results.

Source soil samples were also submitted for PCB analysis. The only detection for PCBs was in UASO010 collected at Grand Mogul Mine. Arochlor 1248 was detected in UASO010 at a concentration of 12 µg/kg.

~~11.4~~ 11.2 AQUEOUS SOURCE RESULTS

Did you photodocument observed releases from adit discharges = Direct Observation

Adit water samples contained varying amounts of TAL total and dissolved metals. Antimony, arsenic, selenium, silver, thallium, and vanadium were non-detect for all total and dissolved samples. Observed total cadmium concentrations ranged from 1.97 µg/L at the American Tunnel portal to 55 µg/L at the Mogul Mine adit. Total copper concentrations ranged from non-detect at the American Tunnel portal and the Red and Bonita portal to 4,030 µg/L at the Gold King 7 Level adit. Total lead concentrations ranged from 3.7 µg/L at the American Tunnel to 271 µg/L at the Mogul Mine adit. Total manganese concentrations ranged from 28,000 µg/L at the Gold King 7 Level to 44,000 µg/L at the American Tunnel portal. Total zinc concentrations ranged from 15,500 µg/L at Red and Bonita Mine to 31,300 µg/L at Mogul Mine.

Observed dissolved cadmium concentrations ranged from 2.02 µg/L at the American Tunnel portal to 53 µg/L at the Gold King 7 Level. Dissolved copper concentrations ranged from non-detect at the American Tunnel portal and the Red and Bonita portal to 4,210 µg/L at the Gold King 7 Level adit. Dissolved lead concentrations ranged from 1.12 µg/L at the American Tunnel to 255 µg/L at the Mogul Mine adit. Dissolved manganese concentrations ranged from 27,800 µg/L at the Gold King 7 Level to 41,700 µg/L at the American Tunnel portal. Total zinc concentrations ranged from 15,400 µg/L at Red and Bonita Mine to 32,700 µg/L at Mogul Mine. See Table 5 for adit water sample results.

~~11.5~~ 11.3 ADIT SEDIMENT SOURCE RESULTS

Adit sediment samples contained varying amounts of total metals. Beryllium and cadmium were non-detect for all samples. Observed antimony concentrations ranged from non-detect at multiple locations to 5.6 mg/kg at the Red and Bonita Mine adit. Observed arsenic concentrations ranged from 19.1 mg/kg at the American Tunnel portal to 126 mg/kg at the Red and Bonita Mine adit. Observed chromium concentrations ranged from non-detect at multiple locations to 7.4 mg/kg at the Red and Bonita Mine adit. Copper concentrations ranged from 11 mg/kg at the Gold King 7 Level to 369 mg/kg at the Red and Bonita Mine adit. Lead concentrations ranged from 59.4 mg/kg at the Red and Bonita Mine adit to 1,740 mg/kg at the Gold King 7 Level adit. Manganese concentrations ranged from 107 mg/kg at the Gold King 7 Level to 2,110 at the Mogul Mine adit. Zinc concentrations ranged from 63.3 mg/kg at Red and Bonita to 361 mg/kg at Gold King 7 Level adit. See Table 6 for adit sediment sample results.

9.2 ~~12.0~~ DATA QUALITY ANALYSIS

~~12.1~~ DATA QUALITY OBJECTIVES

The EPA DQO Process is a seven-step systematic planning approach to develop acceptance or performance criteria for EPA-funded projects. Based upon the risks associated with the hazardous substances, the project team identified surface water and soil exposure as the pathways of potential concern at the site. Surface water and sediment samples were used to determine if there was a significant release of contaminants in the Surface Water Pathway. Soil samples were collected to determine the potential for contamination in Cement Creek by flow over mine waste.

This SR was prompted by the many concerns surrounding the Upper Animas Mining District site. The principal goal of this study was to determine if contamination from the Upper Animas Mining District has migrated into the environment where it is impacting potential environmental and/or human health targets in the surface water pathway.

Fifty-four surface water samples and 54 sediment samples plus 3 duplicate surface water and sediment samples were collected in October 2010 from the Animas River, Cement Creek, and their tributaries within the study area to try to attribute contamination in Cement Creek and the Animas River to various sources.

Fourteen source soil samples and four aqueous source samples were collected in October 2010 from the potential sources and the mines in the Upper Animas Mining District.

All analytical data have been reviewed and verified to ensure that data is acceptable for the intended use (Appendix B). The Data Quality Objectives for this project have been met and the data collected is of sufficient quality to answer the study questions.

12.2 DATA VALIDATION AND INTERPRETATION

All data analyzed by the CLP RAS laboratories were validated by a third party subcontracted chemist. All data are acceptable for use as qualified in the data validation report. The data validation report, laboratory forms, and SQL calculations are presented in Appendix B.

There were some qualifications applied to each inorganic data package associated with this sampling event. The ESAT Inductively coupled plasma mass spectroscopy ICMPS data package DG-216 had a "U" qualifier applied to all silver and molybdenum results because silver and molybdenum were detected in the prep blanks. A "J+" qualifier was added to all beryllium results because the calibration showed slightly high results for beryllium.

The CLP Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) data package MH35H7 for the sediment samples had a qualifier "U" applied to antimony for 11 samples because antimony was detected in the blank. A "U" qualifier was applied to beryllium results for 14 samples because beryllium was detected in the blank. A "U" qualifier was applied to cadmium results for six samples because cadmium was detected in the blank. A "U" qualifier was applied to chromium results for three samples because chromium was detected in the blank. A "U" qualifier was applied to cobalt results for six samples because cobalt was detected in the blank. A "U" qualifier was applied to magnesium results for eight samples because magnesium was detected in the blank. A "U" qualifier was applied to nickel results for six samples because nickel was detected in the blank. A "U" qualifier was applied to selenium results for 18 samples because selenium was detected in the blank. A "U" qualifier was applied to silver results for one sample because silver was detected in the blank. A "J+" qualifier was applied to beryllium results for five samples because of interference check exceedance and positive interference. The "J-" qualifier was applied to thallium for negative interference on 10 samples. All samples had a "J" or "UJ" applied for copper and lead because the original and duplicate were both greater than 5 times the CRDL, and the Relative Percent Difference (RPD) was greater than 20 percent. All samples had a

"J" or "UJ" applied for antimony and silver because the spike recoveries were outside control limits. All samples had a "J+" applied for barium and copper because no post-digest spike was performed. All samples had a "J+" applied for arsenic because spike recoveries were outside control limits. All samples had a "J" or "UJ" applied for arsenic, beryllium, cadmium, copper, nickel, and zinc because the dilutions were greater than 10 percent, and the result was at least 50 times the MDL.

The CLP ICP-AES data package MH35L0 for the sediment samples had a qualifier "U" applied to antimony for nine samples because antimony was detected in the blank. A "U" qualifier was applied to beryllium results for eight samples because beryllium was detected in the blank. A "U" qualifier was applied to cadmium results for four samples because cadmium was detected in the blank. A "U" qualifier was applied to chromium results for two samples because chromium was detected in the blank. A "U" qualifier was applied to cobalt results for two samples because cobalt was detected in the blank. A "U" qualifier was applied to nickel results for one sample because nickel was detected in the blank. A "U" qualifier was applied to selenium results for 10 samples because selenium was detected in the blank. A "U" qualifier was applied to silver results for two samples because silver was detected in the blank. A "J+" qualifier was applied to beryllium results for two samples because of interference check exceedance and positive interference. Thallium was qualified "J+" for interference check exceedance and positive interference in all samples. A "J+" qualifier was applied to silver results for eight samples because of interference check exceedance and positive interference. All samples had a "J-" or "UJ" applied for selenium and thallium because the post-digestion spike recoveries were outside control limits. All samples had a "J" or "UJ" applied for antimony and silver because the post-digestion spike recoveries were outside control limits. All samples had a "J+" applied for arsenic because spike recoveries were outside control limits. All samples had a "J" applied for arsenic, lead, and zinc because the dilutions were greater than 10 percent.

The CLP ICP-AES data package MH35E5 for the sediment samples had a qualifier "U" applied to antimony for all samples because antimony was detected in the blank. A "U" qualifier was applied to beryllium results for 15 samples because beryllium was detected in the blank. A "U" qualifier was applied to cadmium results for ten samples because cadmium was detected in the blank. A "U" qualifier was applied to chromium results for one sample because chromium was detected in the blank. A "U" qualifier was applied to magnesium results for one sample because magnesium was detected in the blank. A "U" qualifier was applied to silver results for two samples because silver was detected in the blank. A "U" qualifier was applied to thallium results for 16 samples because thallium was detected in the blank. A "J+" qualifier was applied to beryllium results for five samples because of interference check exceedance and positive interference. A "J+" qualifier was applied to silver results for 18 samples because of interference check exceedance and positive interference. A "J+" qualifier was applied to thallium results for four samples because of interference check exceedance and positive interference. All samples had a "J" or "UJ" applied for barium and zinc because the original and duplicate were both 5 times the CRDL, and the RPD was greater than 20 percent. All samples had a "J" or "UJ" applied for cadmium because the original and duplicate were both 5 times the CRDL, the absolute difference was greater than the CRQL, and post-digestion spike recoveries were outside control limits. All samples had a "J" qualifier applied for copper because the post-digestion spike recoveries were outside control limits. All samples had a "J" qualifier applied for arsenic, beryllium, cadmium, cobalt, copper, and zinc because the dilutions were greater than 10 percent.

This should be part of Data Quality sections

The CLP ICP-AES data package MH35G5 for the sediment samples had a qualifier "U" applied to antimony for 18 samples because antimony was detected in the blank. A "U" qualifier was applied to beryllium results for 18 samples because beryllium was detected in the blank. A "U" qualifier was applied to cadmium results for 15 samples because cadmium was detected in the blank. A "U" qualifier was applied to chromium results for one sample because chromium was detected in the blank. A "U" qualifier was applied to cobalt results for five samples because cobalt was detected in the blank. A "U" qualifier was applied to magnesium results for nine samples because magnesium was detected in the blank. A "U" qualifier was applied to nickel results for four samples because nickel was detected in the blank. A "U" qualifier was applied to selenium results for 20 samples because selenium was detected in the blank. A "U" qualifier was applied to silver results for seven samples because silver was detected in the blank. A "U" qualifier was applied to thallium results for 17 samples because thallium was detected in the blank. A "J+" qualifier was applied to beryllium results for two samples because of interference check exceedance and positive interference. A "UJ" qualifier was applied to thallium for all samples due to a potentially false negative detection in the interference check. All samples had a "J-" or "UJ" qualifier applied for selenium and zinc because the post-digestion spike recoveries were outside control limits. All samples had a "J" or "UJ" qualifier applied for antimony and silver because the post-digestion spike recoveries were outside control limits. All samples had a "J" qualifier applied for arsenic, beryllium, cadmium, chromium, copper, manganese, nickel, and zinc because the dilutions were greater than 10 percent.

make this section 9.1 and include DQA info I want.

~~13.0~~ 9.1 MEASUREMENT QUALITY OBJECTIVES

renumber ~~13.1~~ FIELD QUALITY CONTROL PROCEDURES

All samples were handled and preserved as described in UOS TSOP 4.2, "Sample Containers, Preservation, and Maximum Holding Times." Calibration of the pH, temperature, and conductivity meters followed instrument manufacturers' instruction manuals and UOS TSOP 4.14, "Water Sample Field Measurements." Sample collection progressed from downstream to upstream to prevent cross-contamination (UOS 2005b).

The following samples were collected to evaluate quality assurance at the site in accordance with the "Guidance for Performing Site Inspections under CERCLA," Interim Final September 1992, the "Region 8 Supplement to Guidance for Performing Site Inspections under CERCLA," and the UOS Generic QAPP (EPA 1992, 1993; UOS 2005a):

- Three double volume sediment samples and three double volume surface water samples were used for a MS/MSD. (The double volume samples were not labeled as separate samples.) The percent recoveries and relative differences were within QC limits except for analytes noted in Section 7.2.
- Three field surface water duplicates were collected; the duplicate sample was blind to the lab. The percent difference for the water samples was 4.3 percent.
- Three field sediment duplicates were collected; the duplicate sample was blind to the lab. The percent difference for the water samples was 22.5 percent.

The UOS Generic QAPP serves as the primary guide for the integration of QA/QC procedures for the START contract (UOS 2005a).

~~13.2~~ DATA QUALITY INDICATORS

Quality attributes are qualitative and quantitative characteristics of the collected data. The principle quality attributes to environmental studies are precision, bias, representativeness, comparability, completeness, and sensitivity. Data quality indicators (DQIs) are specific indicators of quality attributes. The following DQIs were considered during the review of field collection techniques and field QA/QC results, as well as laboratory QA/QC.

13.2.1 Bias

Bias is systematic or persistent distortion of a measurement process that causes errors in one direction. The extent of bias can be determined by an evaluation of laboratory initial calibration/continuing calibration verification, laboratory control spike/laboratory control, interference checks, spike duplicates, blank spike, MS/MSD, method blank, and trip blank.

A review of the ESAT forms for water samples analyzed for metals detected a high bias in the data set DG-216 for beryllium. There was a positive interference for these metals in the interference check samples. These results were qualified as "J+."

A review of the CLP forms for soil/sediment samples analyzed for metals detected a high bias in the data sets MH35G5, MH35E5, MH35H7, and MH35L0 for beryllium. Silver and thallium results were biased high in data packages MH35E5 and MH35L0. There was a positive interference for these metals in the interference check samples. These results were qualified as "J+."

Thallium results were biased low in data packages MH35H7 and MH35G5 because there was a negative interference for these metals in the interference check samples, and the results were qualified "J-/UJ."

13.2.2 Sensitivity

Sensitivity generally refers to the capability of a method or instrument to discriminate between small differences in analyte concentration and is generally discussed as detection limits. Before sampling begins, it is important to compare detection limits and project requirements in order to select a method with the necessary detection limits to meet the project goals. The detection limits are described in the analytical methods.

All detection limits met the CLP requirements; therefore, all sensitivity requirements for the project were met.

13.2.3 Precision

Precision is the measure of agreement among repeated measurements of the same property under identical, or substantially similar, conditions and is expressed as the relative percent difference (RPD) between the sample pairs. The field duplicate and MS/MSD were used to evaluate precision.

The average RPD was 4.3 percent for the surface water samples and 22.5 percent for sediment samples. RPD results are presented in Table 7.

13.2.4 Representativeness

Representativeness is the measure of the degree to which data accurately and precisely represent a characteristic of a population parameter, variations at a sampling point, a process condition, or an environmental condition. Representativeness was achieved by adherence to TSOPs for sampling procedures, field and laboratory QA/QC procedures, appropriateness of sample material collected, analytical method and sample preparation, and achievement of acceptance criteria documented in the FSP for the project. Some deviations from the FSP were documented in the field logbook.

The following deviations from the final FSP, dated October 21, 2010, were made in the field based on assessments made by the UOS project manager:

- Samples UASW038 and UASE038 (Illinois Gulch) were not collected because the confluence of Illinois Gulch and Cement Creek was located on private property for which START did not have an access agreement.
- Samples UASW048 and UASE048 (Elk Tunnel discharge) were not collected because START personnel could not identify any flow from Elk Tunnel.
- Samples UASW051 and UASE051 (Mammoth Tunnel discharge) were not collected because START personnel could not identify any flow from Mammoth Tunnel.
- Samples UASW053 and UASE053 (Cement Creek downstream of Prospect Gulch) were not collected because they were located on private property for which START did not have an access agreement.
- Samples UASW055 and UASE055 (Cement Creek upstream of Prospect Gulch) were not collected because they were located on private property for which START did not have an access agreement.
- Samples UASW057 and UASE057 (Dry Gulch discharge) were not collected because START personnel could not identify any flow from Dry Gulch.

- The planned location for samples UASW011 and UASE011 was below all of the Gold King 7 Level waste piles. These samples were instead collected where runoff from the upper piles crosses the mine access road. The planned location could not be safely accessed at the toe of the lower piles due to an extremely steep slope, loose material, and snow.
- In addition to adit water, sediment samples were collected from adit discharge points, as START determined it would provide additional information.
- Fewer soil samples than planned were collected. START personnel dug below snow in several locations on each pile and performed XRF analysis of the driest soil in the hole. In-situ XRF analysis showed waste piles were more homogeneous that expected, so the number of samples required for characterization was reduced.
- Soil samples collected in the vicinity of the American Tunnel, UASO001 and UASO002, were obtained from 0 to 1 inch below ground surface because the ground was frozen and the planned depth of 6 inches could not be obtained.
- Soil samples were not collected at the Gold King 7 Level Mine because the waste piles for which START had an access agreement could not be accessed due to unsafe conditions, including extremely steep slope, loose waste rock material, and snow.
- A sediment sample for PCB analysis was not collected at UASE059 (at the toe of Grand Mogul Mine) because there was not enough sediment available for both metals and PCB analysis. Metals analysis was deemed more critical to project goals.
- A sediment sample for PCB analysis was not collected at UASE012 (above Gold King 7 Level Mine) because there was not enough sediment available for both metals and PCB analysis. Metals analysis was deemed more critical to project goals.
- A sediment sample for PCB analysis was not collected at UASE030 (Cement Creek upstream of Grand Mogul Mine) because there was not enough sediment available for both metals and PCB analysis. Metals analysis was deemed more critical to project goals.
- Sample AD005 was not collected because there is no adit discharge from Grand Mogul Mine.

- Surface water and sediment samples were not collected at locations 025, 026, 027, 028, and 031 because START was not able to reach the highest elevations due to snowy and potentially unsafe conditions.
- Soil samples were not collected from the Queen Anne Mine, the Adelphin Mine, and the Columbia Mine because START was not able to reach the highest elevations due to snowy and potentially unsafe conditions.

13.2.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system. The percent completeness for this project was 81 percent. Samples were collected in accordance with the FSP, except where snowy and/or hazardous conditions or access restrictions prevented collection of planned samples.

Did this result in data gaps that should be filled?

13.2.6 Comparability

Comparability is the qualitative term that expresses the confidence that two data sets can contribute to common interpretation and analysis and is used to describe how well samples within a data set, as well as two independent data sets, are interchangeable. Validated lab data were obtained to ensure comparability to previous sampling events. All samples were sent to a CLP laboratory or the Region 8 ESAT laboratory, and all data were validated (Appendix B).

All samples were collected using the same FSP, TSOPs, and sampling equipment; therefore, all sample data are comparable.

Are study questions answered and are data ok for intended use?

14.0 SUMMARY

add to summary if you have other changes to source & pathway info that help better describe the area's impact to the Animas River within the Upper Cement Creek portion of the Upper Animas Mining District

The Upper Animas Mining District has a 100-year history of mining and milling in the mountains surrounding Silverton, Colorado. Sources ~~at the site~~ include mine waste rock and mine adit discharge from several mines contributing metals contamination to Cement Creek and the Animas River.

An observed release to the surface water pathway was documented in October 2010. A release of cadmium, manganese, lead, copper, and zinc was documented and observed by START. The copper, cadmium, and lead concentration in surface water samples were all 3 times the surface water background and exceed the MCL. The manganese concentrations in surface water samples were 3 times background and exceed the RDSC. The zinc concentrations in surface water samples were 3 times background and exceed the RDSC.

The impact of metals from the mining waste and adit discharges was evident by the orange and yellow precipitate found along Cement Creek. The metals may be directly affecting the fisheries in the Animas River and the wetlands along Cement Creek.

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